

SYSTEM FOR DESALINATING AND PURIFYING SEAWATER AND DEVICES FOR THE SYSTEM

FIELD OF THE INVENTION

In general, the present invention relates to a system for desalinating and purifying seawater until the seawater becomes drinkable, and more particularly to a system that has a cyclically desalinating process and a repeatedly purifying process to crack elements in water molecules in the seawater to tiniest molecules and therewith to reform to become drinkable water derived from the oceans. Wherein, viruses, heavy-metallic pollutants and futile elements contained in the seawater are separated and removed to make the fresh water safe without extra treatment and molecular elements contained in the generated drinkable water easily absorbed and utilized by human body.

BACKGROUND OF THE INVENTION

Recently, water supplement becomes a worldwide problem. People will face the water shortage in the futures and need an effective solution to resolve the problem of water shortage. Although the earth contains plenty of water, most of the water is seawater (salt water) in the oceans and is not drinkable because the seawater contains too much crude salt containing sodium chloride, non-metallic elements, heavy metals and thousands of unknown elements. Several desalinating methods for the seawater or brine are developed and mainly classified into two types. One type is to use membrane isolation such as reverse-osmosis or electrodialysis. The reverse-osmosis is suitable for desalinating seawater and the electric dialysis is suitable for treating brine containing less quantity of salt. With regard to the reverse-osmosis, electricity consumption and membrane reloading cause an inevitable spending that takes a majority portion in an operational cost of reverse-osmosis. Another type is to distill the seawater, which is a

1 common method used to separate high-volatility materials from non-volatility and
2 low-volatility materials. Wherein, the high-volatility materials are vaporized to obtain
3 the non-volatility and low volatility materials or further the vaporized high-volatility
4 materials are cooled to obtain pure liquids thereof. Distillation-type desalinating
5 methods comprise multi-effect Distillation (MSD), multi-stage flash (MSF), vapor
6 compression (VC) etc. and basically reuse generated heat in an operational system to
7 serve as a heat source of distillation. Therefore, the distillation-type desalinating
8 methods focus on improving thermal-transmission efficiency of equipment in this
9 method.

10 The foregoing reverse-osmosis method is operated by simple equipment and
11 simple operational procedures and is selectively designed to be small modules or
12 combined with other desalinating systems to become a large-scale desalinating system in
13 a factory. But the reverse-osmosis method has high operational pressure and need more
14 electricity to operate the equipment so that operating cost of the reverse-osmosis method
15 is high. Although the distillation-type desalinating method uses waste heat as a power
16 source, vaporizing and condensing processes must be hold in two separated chambers so
17 that equipment of the distillation-type desalinating method occupies more space than
18 that of the reverse-osmosis method. Additionally, the distillation-type desalinating
19 method is difficult to be operated and controlled. Up to now, the two conventional types
20 of desalinating methods both have high costs and the generated water has less
21 competitive capabilities with naturally obtained fresh water. Moreover, still another
22 desalinating method, so-called membrane-distillation method, which combines
23 advantages of the membrane-osmosis method and the distillation method together.
24 However, the membrane-distillation method has low producing rate (water quantity/per

volume unit of equipment) and is easily malfunctioned by blocking porous membranes with crystallization. Therefore, the membrane-distillation method is not widely applied in desalinating systems.

Additionally, still several conventional treatments for tap water are listed and compared in the followings:

1. Boiling method: boiling method can kill bacteria in water but can not remove harmful impurities from water. Moreover, the tap water mostly contains chlorides therein and the chlorides easily become cancer-inducing material, chloroform, after boiling.

2. Filtering method with active carbon: the active carbon can absorb organic materials and colloids in the water and deodorizes the tap water, but the active carbon has to be changed very often.

3. Ion-exchanging method: ion-exchanging resin is applied to remove metallic ions, such as sodium, magnesium, and calcium ions etc., from the tap water to soften the tap water but can not purify the tap water.

4. Ultraviolet (UV) lighting method: the UV lighting method can kill the bacterial but can not remove salt, colloid, particles, and other chemicals from the tap water.

5. Depositing method: the depositing method can not kill bacteria and viruses and can not eliminate heavy metals and toxic chemicals in the tap water.

Moreover, water obtained from desalinated seawater by the conventional desalinating methods still contains some salt and some mineral materials (metallic or non-metallic materials) and is only suitable for washing or irrigation, but is not drinkable. Therefore, the water has to be mixed with fresh water to further boil or filter again to

1 become drinkable. With regard to water obtained from distillation-type desalinating
2 method, the water is almost pure water but still contains some sodium and halogen
3 elements because compounds containing sodium and halogen are vaporized and then
4 reduced into the water after condensation so that the water is harmful to metabolism
5 system of human body if the water is drank without any extra treatment to remove the
6 sodium and halogen compounds. Moreover, some beneficial mineral materials in the
7 water are decomposed after distillation.

8 According to foregoing desalinating methods, these methods have less concern
9 about the purification. Without purification, the water obtained from desalinating
10 methods still contains small quantity of salts and mineral materials and is not drinkable.
11 For the conventional desalinating methods in present, majority of salt and gesso are
12 removed from the seawater but the generated water obtained from desalinating still
13 contains sodium and halogen elements and is harmful to metabolism system of human
14 body. Additionally, specifically for distillation-type desalinating method, the boilers in
15 the operational system are easily coated with limescale and corroded by corrosive
16 materials in the seawater so that operational system of this method has to be interrupted
17 to clean or change the boilers. Therefore, the boilers have short utility periods and an
18 operational cost of the distillation-type desalinating method is increased.

19 SUMMARY OF THE INVENTION

20 The present invent invention provides a system for desalinating and purifying
21 seawater to overcome these drawbacks in the conventional desalinating methods by
22 using a heating unit, a desalinating cracking unit, and a purifying distilling unit
23 cyclically arranged in this system and further by incorporating with a dissociating
24 reducing device proceeding a multi-desalinating process and multiple distillatories

proceeding a repeatedly purifying process to reform the seawater into drinkable water without extra treatment. Moreover, molecular elements in the generated drinkable water can be absorbed and utilized by human body after drinking.

The system for desalinating and purifying seawater in the present invention essentially imitates natural circulation of water on the earth. Rotation of the earth makes the oceans to generate cold and warm currents to convect with each other so that frictions between the currents are generated under the sea. By the frictions, toxic elements and pollutants in the seawater are vaporized, cracked, and then reformed to become other synthetic elements and materials. Additionally, radiation of sunlight penetrates the atmosphere layer and is refracted by different water molecular groups in the atmosphere layer to cause electronic mobility. Therefore, when the sunlight radiates the seawater with highly thermal radiation to vaporize water, vaporized water molecules has multi-friction with the radiation during vaporization. Light elements in the seawater are vaporized to join the atmosphere layer and residual elements in the seawater are cracked by friction and reformed to become tinier water molecular groups. Mostly, elements having high specific gravity and organic pollutants are cracked. For example, organic pollutants such as bacteria and odors can be decomposed by oxidizing reaction caused from lighting titanium dioxide by UV light. Wherein, the titanium dioxide generates a pair of electron and electron hole and then generates free hydroxide radical (OH^\cdot) having high oxidizing capability to decomposed the bacteria and odor to purify the seawater. The vaporized water molecules are cooled by air and condensed to become raindrops falling to the ground. Some raindrops falling into rivers dissolve impure elements on the ground and return to the ocean. The raindrops in the ocean are recombined with other elements in the ocean to become the seawater. Some raindrops

are stored on the ground to perform lakes or permeate the ground to become groundwater. The raindrops are filtered by multiple geology strata to become pure groundwater (the cleanest original water) that has different quality and quantity with water on the ground. Principles and techniques in the present invention are essentially based on the natural circulation of water and imitate vaporization caused by heat of the earth core. Additionally, a desalinating cracking unit in the system of the present invention has a dissociating reducing device, which has functions similar as those of the earth geologic strata and ground, attached to a bottom of the desalinating cracking unit.

A first technical character of the present invention is that the system comprises multiple separable devices including a top layer, a bottom layer, and an outer cooling assembly, and four units arranged within corresponding layers and the outer cooling assembly to allow the system to be constructed and cleaned easily. The devices are made of ceramics or other materials having excellent thermal-conducting and anti-corrosive capabilities to eliminate coating of limescale and corrosion to the devices so as to avoid malfunction of the devices. Additionally, the heating unit has an impurity depositing area with an impurity outlet attached to a bottom of the heating unit to collect and discard impurity and non-volatile materials via the impurity outlet.

A second technical character of the present invention is that the heating unit is modified to comprise a heater to heat the seawater inside the system to cause currents flowing in the system to accelerate boiling of the seawater.

A third technical character of the present invention is that the desalinating cracking unit has at least one steam heater to provide extra heating efficiency and to drive the seawater to vortically rotate when the seawater boils.

A fourth technical character of the present invention is that the desalinating

1 cracking unit has a dissociating reducing device having similar functions as those in the
2 geologic strata and the ground. By impact effects of the steam induced by the steam
3 heater and the dissociating reducing device, vibrational cracking occurs to crack and
4 reform the water molecules in the steam. Heavy metals and heavy water in the seawater
5 are separated from light elements in the water molecules in the steam and further
6 conducted to the heating unit to be vaporized again. The steam of water molecules
7 containing light elements is conducted to the purifying distilling unit in the top layer.

8 A fifth technical character of the present invention is that the purifying distilling
9 unit comprises multiple distillatories. Each distillatory is composed of multiple
10 manifolds. By a physically inducing effect caused by impact of high temperature steam
11 and the multiple manifolds, the steam is further sieved to allow tiny elements in the
12 water molecules in the steam to pass through the purifying distilling unit to reach the
13 outer cooling assembly. Residual steam unable to pass through the purifying distilling
14 unit is conducted back to the desalinating cracking unit in the bottom layer.

15 BRIEF DESCRIPTION OF THE DRAWINGS

16 Fig. 1 is a schematically flowchart of a system for desalinating and purifying
17 seawater in accordance with the present invention; and

18 Fig. 2 is a cross-sectional side plane view of devices applied to the system in the
19 present invention.

20 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

21 A system for desalinating and purifying seawater in the present invention is
22 shown schematically in Fig. 1 in a generalized fashion. The system is designed for a
23 separably multilayer configuration and comprises multiple devices containing a bottom
24 layer (A), a top layer (B), and an outer cooling assembly (C) and four units

1 correspondingly arranged in the multiple devices. The bottom layer (A) contains a
2 heating unit (10) and a desalinating cracking unit (20). The top layer (B) contains a
3 purifying distilling unit (30) and the outer cooling assembly (C) contains a cooling unit
4 (40). Initially, the seawater is conducted into the heating unit (10) and partially vaporized
5 to form steam flowing into the desalinating cracking unit (20). The heating unit (10) and
6 the desalinating cracking unit (20) communicate with each other to achieve a cyclically
7 and repeatedly desalinating process (as shown by arrows in Fig. 1). The seawater mixed
8 with the steam runs in the cyclically and repeatedly desalinating process until
9 non-boiling and non-crackable materials are generated in the seawater. The non-boiling
10 and non-crackable materials in form of crystallization and are collected in the heating
11 unit (10) by deposition and then drained with waste water (heavy water). After running
12 in the cyclically desalinating process, the steam is conducted into the purifying distilling
13 unit (30). Additionally, the desalinating cracking unit (20) and the purifying distilling
14 unit (30) also communicate with each other to achieve a cyclically and repeatedly
15 purifying process. In the purifying distilling unit (30), part of the steam unable to pass
16 through the purifying distilling unit (30) is conducted back to the desalinating cracking
17 unit (20). Residual tiniest steam and tiny elements within the water molecule able to pass
18 through the purifying distilling unit (30) are conducted to the cooling unit (40) in the
19 outer cooling assembly (C) to be condensed and deodorized to finally achieve drinkable
20 water.

21 With reference to Fig. 2, preferred embodiments of the devices applied to the
22 system for desalinating and purifying seawater are shown in a general fashion. A
23 desalinating and purifying combination (Z) has a separably multilayer configuration and
24 comprises a bottom layer (A), a top layer (B), an outer cooling assembly (C), and four

1 units arranged in the desalinating and purifying combination (Z). The bottom layer (A)
2 contains a heating unit (10) and a desalinating cracking unit (20). The top layer (B)
3 contains a purifying distilling unit (30) and the outer cooling assembly (C) contains a
4 cooling unit (40) and a deodorizing system (403). The bottom layer (A) has a bottom and
5 the heating unit (10) is constructed at the bottom of the bottom layer (A). The heating
6 unit (10) with a base (not numbered) has at least one heater (101), at least one steam
7 heater (108), a heating chamber (102), a water inlet (103), an impurity depositing area
8 (104), an impurity outlet (105) and a waste water outlet (106). The at least one heater
9 (101) connects to the base of the heating unit (10) to directly receive heat generated from
10 a heating device (70). Preferably, the at least one heater in the heating unit comprises
11 multiple stainless steel tubes evenly arranged in a circle. The heating chamber (102) has
12 an inner wall made of thermal-conductive and anti-corrosive material to serve as a
13 thermal-exchanging wall (1021). The at least one steam heater (108) is a cone object
14 composed of multiple circular steam pipes and further has an outer steam pipe (1081)
15 surrounding around and connecting with an outer periphery of the cone object. Multiple
16 obliquely gas nozzles (1083) are respectively attached to the cone object of the steam
17 heater (108) and the outer steam pipe (1081). A steam inlet (1082) is formed at one side
18 of the outer steam pipe (1081) and a waste gas exhaust (107) is formed at another side to
19 be opposite to the steam inlet (1082). The at least one heater (101) and the heating
20 chamber (102) simultaneously heat the seawater to cause circulation and to accelerate
21 the boiling of the seawater. The steam heater (108) heats the seawater to make the
22 seawater to generate a vortical circulation and to further accelerate the boiling of the
23 seawater so that more steam is generated to flow into the desalinating cracking unit (20).
24 Wherein, the steam inlet (1082) introduces extra steam from outside boilers into the

1 heating chamber (102) to provide additional thermal energy. The water inlet (103)
2 communicates to the heating chamber (102) to supply the seawater from the oceans by
3 pumps into the heating unit (10). The impurity depositing area (104) is defined at the
4 bottom of the bottom layer (A) to store deposited impurities in the seawater and the
5 impurity outlet (105) communicates to the impurity depositing area (104) to drain the
6 deposited impurities out of the heating unit (10). The waste water outlet (106)
7 communicates to the heating chamber (102) above the impurity depositing area (104) to
8 conveniently drain residual heavy water out of the heating unit (10). The waste gas
9 exhaust (107) also communicates to the heating chamber (102) above the waste water
10 outlet (106) to exhaust anhydrous gas out of the heating unit (10).

11 The desalinating cracking unit (20) above the heating unit (10) contains a
12 dissociating reducing device (202) and a containing chamber (203) defined around the
13 dissociating reducing device (202). The dissociating reducing device (202) is composed
14 of multiple cracking layers (2021) vertically piled together and is in shape of cylinder.
15 Preferably, the reducing device (202) is designed for a boiler. Wherein, each cracking
16 layer (2021) has a top plate (2023), a bottom plate (not numbered) and multiple
17 manifolds (2022) arranged between the top and the bottom plates. The top plate (2023)
18 and the bottom plate are made of stainless steel and both have multiple round holes
19 (20231) defined thereon. The containing chamber (203) has an inner wall made of
20 thermal-conductive and anti-corrosive material. The at least one steam heater (108) in
21 the heating unit (10) and the dissociating reducing device (202) interact each other to
22 cause vibrating and cracking effects to dissociate and crack water molecules in the
23 seawater. Thereby, heavy metal and heavy water are separated from light elements in the
24 water molecules. Heavier and impure seawater is conducted back to the heating unit (10)

1 to be vaporized again. Lighter and cleaner steam is introduced into the purifying
2 distilling unit (30) in the top layer (B). In the desalinating cracking unit (20), the
3 seawater in the containing chamber (203) are basically divided into two layers, one layer
4 is an upper layer contains the lighter and cleaner seawater after cracking and
5 desalinating, the other layer is a lower layer in where the seawater is cracking.

6 The top layer (B) contains the purifying distilling unit (30) composed of
7 multiple distillatories (301). Each distillatory (301) has multiple manifolds (3011) and a
8 steam chamber (302) is defined around the multiple distillatories (301). The steam
9 chamber (302) has an inner wall made of thermal-conductive and anti-corrosive material.
10 The multiple manifolds (3011) in each distillatory (301) and the multiple distillatory
11 impact with high temperature steams pressure to cause a physically inducing effect.
12 Thereby, water molecules in the steam are sieved to allow the tiniest steam and tiny
13 elements in the water molecules passing through the purifying distilling unit (30) to
14 reach the outer cooling assembly (C). Residual steam unable to pass through the
15 purifying distilling unit (30) is conducted back to the desalinating cracking unit (20) in
16 the bottom layer (A).

17 Additionally, the bottom layer (A) and the top layer (B) are detachably and
18 air-tightly combined by means of engaging ring (201) to construct a cylindrical tower.

19 The outer cooling assembly (C) containing the cooling unit (40) and the
20 deodorizing system (403) is connected to the top layer (B) via a pipe (401). Each cooling
21 unit (40) has at least one cooling column (402), multiple coolers (4021) accommodated
22 inside each cooling column (402), and a water chamber (4022) defined around the
23 multiple coolers (4021) in the corresponding cooling column (402). The sieved steam
24 from the purifying distilling unit (30) is introduced into the at least one cooler (4021) via

1 the pipe (401) to further be condensed. A water outlet (4024) is attached to a top of the
2 cooling column (402) and a water inlet (4023) is attached to a bottom of the cooling
3 column (402) to introduce cool water, iced water, or the seawater into the water chamber
4 (4022) to condense the steam to become condensing water. After condensing the steam,
5 the cool water, iced water or the seawater in the cooling column (402) becomes hot and
6 is drain out via the water outlet (4024). Selectively, the hot seawater is directly
7 introduced into the heating unit (10) to process in the desalinating and purifying system
8 to avoid thermal waste. The condensing water is conducted to the deodorizing system
9 (403) below the cooling column (402), wherein the deodorizing system is filled with
10 deodorizing material or de-chloride materials such as active carbon to purify the
11 condensing water. Lastly, the purified water is drained out via an outlet (404) and
12 collected in a container (405).

13 The seawater is filtered by a filtering device (50) before introduce into the
14 system to remove large particles from the seawater. Then, the filtered seawater is
15 conducted into the heating chamber (102) in heating unit (10) via the outer inlet (103) to
16 reach a water level (W) over the dissociating reducing device (202) in the containing
17 chamber (203) of the desalinating cracking unit (20). The heating device (70) secured on
18 the base of the heating unit (10) selectively use fuel gas, gasoline, electricity or solar
19 energy or steams as power to supply heat to the heater (101) in the heating unit (10). The
20 heater (101) is composed of multiple stainless steel tubes (1011) arranged in cylinder
21 and thus has large heating areas to cause the heated seawater to circulate in the heating
22 chamber (102) to accelerate boiling of the seawater. Because the inner wall of the
23 heating chamber (102) is a heat-exchanging wall made of thermal-conductive and
24 anti-corrosive material, the inner wall of the heating chamber (102) absorbs thermal

1 energy from the heated seawater to evenly heat the seawater in the entire heating
2 chamber (102) to accelerate boiling of the seawater. After boiling, light elements and
3 water molecules are transformed into steam bubbles to arise to the steam heater (108) in
4 the seawater. The steam heater (108) and the outer steam pipe (1081) further heat the
5 steam up and the obliquely gas nozzles (1083) inject gas to drive the seawater to
6 vortically rotate to accelerate the boiling. Meanwhile, the steam bubbles in the steam
7 heater (108) rapidly raise to the desalinating cracking unit (20). Additionally, the steam
8 inlet (1082) attached on one side of the outer steam pipe (1081) introduces extra steam
9 for heating and the waste gas exhaust (107) drain anhydrous waste gas out of the steam
10 heater (108). After arrive the desalinating cracking unit (20), the steam bubbles pass the
11 round holes (20231) on the bottom plate to impact with the dissociating reducing device
12 (202) at high temperature and at high speed. The dissociating reducing device (202)
13 generates a vibrating reaction to dissociate heavy elements such as toxic elements, heavy
14 metal compounds, salts, and calcium carbonate and to separate these heavy elements
15 from light elements in the water molecules. Since the seawater impact with the
16 dissociating reducing device (202) to provide thermal energy, hydrogen and oxygen
17 elements in the water molecules enable to be burned to accelerate vaporization of the
18 light elements in the water molecules and other trace elements dialyzed from the
19 seawater. The heavy elements are recombined with the heavy water and sunk to the
20 heating unit (10) to re-boil again. The light elements with the water molecules arise to
21 the desalinating cracking unit (20) and repeatedly boiling and cracking processes until
22 non-boiling and non-cracking impurities generate. The impurities are deposited and
23 collected in the impurity depositing area (104) and then drained out via the impurity
24 outlet (105). The impurities enable be properly treated and reused.

1 After dissociate in the dissociating reducing device (20), the light elements with
2 water molecules in form of steam depart from the water level (W) and enter the steam
3 chamber (302) in the purifying distilling unit (30). The steam compact with the
4 manifolds (3011) in the multiple distillatories (301) to cause a physically conducting
5 effect and is sieved to allow tiniest water molecules carrying tiny elements to pass
6 through the purifying distilling unit (30) to reach the outer cooling assembly (C). Each
7 distillatory (301) is an inverted dome with a top convex surface and a bottom concave
8 surface to gather and guide residual steam back to the desalinating cracking unit (20) to
9 crack again and regenerate steam. The tiniest water molecules with tiny elements are still
10 in form of steam called distillation steam in the following description. The distillation
11 steam is introduced into the cooling unit (40) in the outer cooling assembly (C) via the
12 pipe (401) and condensed by the multiple coolers (4021) in the cooling column (402).
13 When condense the distillation steam, cool water, iced water, or the seawater is
14 introduced into the water chamber (4022) via the water inlet (4023) to carry out
15 heat-exchange with the distillation steam and then is drained out of the water chamber
16 (4022) via the water outlet (4024). Therefore, the distillation steam can be rapidly
17 condensed to become condensing water. Selectively, the seawater getting hot in the
18 water chamber (4022) is directly introduced into the heating unit (10) to process in the
19 desalinating and purifying system to save more thermal energy. Then, the condensing
20 water is conducted to the deodorizing system (403) below the cooling column (402),
21 wherein the deodorizing system (403) is filled with deodorizing material or de-chloride
22 materials such as active carbon to purify the condensing water. Lastly, the purified water
23 is drained out of the deodorizing system (403) via the outlet (404) and collected in the
24 container (405).

1 Preferably, the seawater is pre-treated with the filtering device (50) to remove
2 large particles from the seawater before feeding into the heating chamber (102) in the
3 heating unit (10). Thereby, operational period of the system is shortened and impurities
4 in the system are decreased.

5 When the system needs to be cleaned, a detergent supplier (60) is connected to
6 the water inlet (103) to input detergent into the system, wherein the detergent is preferred
7 to be non-toxic citric acid. The waste water outlet (106) and the impurity outlet (105)
8 enable to respectively drain residual heavy water and impurities out the system. Because
9 the inner walls of the heating chamber (102) and the containing chamber (203) are made
10 of stainless steel, devices in the system are not easily coated with limescale and not be
11 corroded by the seawater to reduce frequency of cleaning the system.

12 Main feature of the present invention is to use cyclically and repeatedly
13 desalinating processes and purifying processes to purify the seawater to generate
14 drinkable water containing trace elements that is beneficial for human body.

15 Although particular and specific embodiments of the invention have been disclosed in
16 some detail, numerous modifications will occurs to those having skill in the art, which
17 modifications hold true to the spirit of this invention. Such modifications are deemed to
18 be within the scope of the following claims.